

[SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF]

Abstract

A method of manufacturing a semiconductor device is provided. First, a well region is formed in a substrate and then a mask layer is formed over the substrate. The mask layer and the substrate are patterned to form a first opening in the substrate. Thereafter, a threshold voltage adjustment process is performed. A gate dielectric layer, a first conductive layer and a second conductive layer are sequentially formed inside the first opening. The second conductive layer completely fills the first opening. A portion of the first conductive layer and the second conductive layer are removed so that the upper surface of the first conductive layer and the second conductive layer is slightly below the upper surface of the substrate and hence forms a second opening. A cap layer is formed in second opening and then the mask layer is removed. A source/drain region is formed in the substrate on each side of the first conductive layer. An inter-layer dielectric layer is formed over the substrate. Finally, using the cap layer as a self-aligned mask, a contact opening is formed in the inter-layer dielectric layer.